COASTAL PLAIN FLOODPLAINS

Concept: Coastal Plain Floodplain communities occur on alluvial soils in areas that are presently or were recently influenced by overbank flooding by rivers or streams. Characteristic vegetation distinguishes these communities even where flooding is rare or has been eliminated by dams, stream incision, or other alterations.

Distinguishing Features: Coastal Plain Floodplain communities are distinguished by occurring in floodplains, on alluvial soils, and by having vegetation characteristic of one of the included communities. Where vegetation of Coastal Plain Nonalluvial Wetland Forests and Freshwater Tidal Wetlands looks similar, they may be distinguished by evidence of river flooding and absence of tidal flooding.

Within this theme, communities are distinguished by water type (brownwater, blackwater, or intermediate), and by landforms on which they occur, with vegetation, presumed fauna, and ecosystem processes varying accordingly.

Brownwater rivers are those that enter the Coastal Plain from the Piedmont and have turbid water with a high suspended load of clay and silt. Floodplain soils range from sandy to clayey and are fertile, while larger rivers tend to have well-developed natural levees. Blackwater rivers and streams contain water primarily originating in the Coastal Plain. They have low suspended loads of silt and clay, with water stained by tannins but not turbid. Floodplain soils tend to be sandy or organic and are low in fertility. Intermediate situations exist along streams that originate in clayey areas of the Coastal Plain or where calcareous rocks mitigate the acidity of blackwater streams. Most community types or subtypes have distinctly different vegetation associated with brownwater and blackwater, and sometimes distinct intermediate communities can be recognized.

Nonforested communities occur in areas with permanent water and on recently deposited surfaces. Coastal Plain Semipermanent Impoundments are communities influenced by impounded waters of beaver ponds; old mill ponds that resemble beaver ponds are also included. They range from open water to forests that resemble Cypress–Gum Swamp except in the permanent water and altered lower strata. Oxbow Lakes are permanently flooded communities in abandoned channel segments that are not connected to the river at normal low water. They may have little vegetation or may have open water surrounded by marshy or forested edge zones. Sand and Mud Bar communities are distinguished by occurring on recently deposited sediments along the river bank, lacking a full forest canopy because of frequent flood scouring or lack of time for primary succession to establish a forest.

Among forested floodplain communities, Cypress–Gum Swamps occur in the wetter sloughs and backswamps and are distinguished by strong dominance of *Taxodium* or *Nyssa* species. Bottomland Hardwoods occur on floodplain ridges and terraces where *Quercus* and *Liquidambar* tend to dominate. Levee forests are those on the natural levee adjacent to brownwater river channels, where very active alluvial deposition, high fertility, edge effect of the river, and other environmental factors support diverse forest communities. Blackwater rivers generally do not have distinct natural levees, but a distinctive Blackwater Levee/Bar Forest community may occur on forested point bar deposits. In smaller floodplains, the alluvial landforms are too small to

differentiate communities, and a single Coastal Plain Small Stream Swamp, Sandhill Streamhead Swamp, or Cypress–Gum Swamp community occupies the entire floodplain.

Synonyms:

Sites: All Coastal Plain Floodplain communities occur in floodplains, where overbank flooding by a river or stream shapes the community. Coastal Plain Floodplains usually have depositional landforms created by flooding, alluvial deposition, and channel migration: natural levees, sloughs, backswamps, ridge and swale systems, and point bar deposits. On larger rivers, these can have substantial relief. Smaller streams may have similar depositional landforms on a smaller scale, but some have uniformly flat floodplains. Beavers may impound sloughs or smaller streams to create ponds and areas with raised water tables.

Many Coastal Plain rivers have large terraces created in the Pleistocene. Many rivers are underfitted: the present day floodplain is much smaller than the Pleistocene floodplain, and the terraces reflect a larger channel, wider meanders, and larger depositional landforms. Some channel segments are bound in older large channels, while other segments are in more recently formed meander belts.

Soils: Soils include a variety of alluvial soils, often Incepticols and Entisols, sometimes Ultisols on the older terraces. Histosols often occur in wetter swamp areas, especially on blackwater rivers and smaller streams. They may be local, in sloughs, or may fill an entire floodplain. Soil textures vary widely. Sandy soils prevail on natural levees and may predominate on all higher landforms in blackwater floodplains. Brownwater floodplains may have extensive loamy soils. Soils may be clay-rich in brownwater backswamps, while comparable sites on blackwater rivers have organic deposits.

Hydrology: Coastal Plain floodplains generally flood more frequently and for longer duration than Piedmont and Mountain floodplains, but flooding regimes vary substantially. Limited areas such as beaver ponds and oxbow lakes are flooded all year, but more abundant low areas may be flooded well into the growing season. On brownwater rivers, natural levees may trap flood waters behind them, resulting in slow drainage and in floods that last after the river has dropped. In contrast, higher terraces and the highest natural levees may be flooded only briefly, in the deepest floods. Floodwaters initially are flowing, but they may become still in wetter swamps, resulting in anoxic conditions and deposition of the finest texture sediments.

When not flooded, soil drainage varies drastically. The sandy soils, especially on natural levees adjacent to steep banks, may be well drained. Clayey or organic soils in sloughs and backswamps may remain saturated well after floodwaters recede.

River and stream channels may vary in form. Most are meandering single channels, but some have braided or anastomosing channel networks. A few have no visible channel and carry floodwaters throughout a broad flat floodplain. Pleistocene terraces occasionally show a different pattern from the present, with evidence of braided channels where rivers are now meandering (Leigh et al. 2004). The factors that cause these different patterns are not clear. Rivers or streams with different patterns sometimes occur in close proximity.

Vegetation: Coastal Plain Floodplain vegetation varies extremely widely. Most communities are forested, and canopy composition varies in broad categories. Cypress–Gum Swamps, in the wettest forested sites, are dominated by *Taxodium* and *Nyssa* and tend to be low in species richness. Bottomland Hardwoods in less wet sites are dominated by *Quercus*, in combination with *Liquidambar*, *Carya*, or *Pinus*, and are moderate in species richness. Brownwater Levee Forests, on the natural levee deposits along the river, have a more diverse suite of characteristic trees, including *Platanus occidentalis*, *Betula nigra*, *Fraxinus americana, Celtis laevigata, Ulmus americana, Juglans nigra, Acer negundo*, and others, along with species of oaks, hickories, and *Liquidambar*. In addition to understory trees, shrubs, and herbs, woody vines are more prominent and diverse in Coastal Plain floodplains than in any other communities. Communities of blackwater rivers are less diverse than those of brownwater rivers; their species composition is generally a subset of the same species but they may share some species with nonriverine wetlands.

Dynamics: Coastal Plain floodplains have complex dynamics because of the interplay of multiple processes, some of them common to most forests, some unique to floodplains.

Natural vegetation dynamics of most of the forest communities are similar to those of most upland hardwood forests, with long-lived trees dominating, tree populations multi-aged, and tree replacement primarily in small gaps. Despite the prevalence of flooding, most trees are killed by wind, lightning, or disease rather than wetness or scouring. Hurricanes may cause widespread canopy disruption, creating some medium or larger gaps as well as more numerous small gaps. Effects of a severe hurricane on the Congaree River in South Carolina (Zhao et al. 2006) would probably be similar on North Carolina rivers, at least brownwater rivers. Those effects included creation of some large canopy gaps and numerous smaller gaps. This storm varied in favoring shade-intolerant trees in some areas but increasing shade-tolerant trees elsewhere. It had similar variable effects on species diversity.

The natural levees and channel banks may be particularly susceptible to wind throw because of the sandy soils and exposure on the open edge. Tree species of these communities also tend to be shorter lived but are particularly fast-growing. Cypress–Gum Swamps may be particularly stable, given the extreme longevity of *Taxodium*. Both *Taxodium* and *Nyssa* are well adapted to withstanding wind, and extensive wind throw is limited even in major hurricanes. *Quercus*-dominated bottomland hardwoods are intermediate; hurricanes have been observed to have caused substantial canopy tree mortality in patches.

Woody vines are a particularly prominent part of floodplain communities, where they have more species diversity and perhaps more biomass than in any other North Carolina communities. The author has observed proliferation of vines in floodplains following severe disturbance by both storms and logging. The vine cover appears to be heavy enough to inhibit tree regeneration, but the long-term development of such areas is not known. Older treeless vine-dominated areas are not known. Studies in South Carolina have suggested that vines may have increased in density in brownwater floodplains in both old-growth and second-growth forests in recent decades, a pattern also observed in some tropical forests (Allen et al. 2005, 2007). However, the extreme variability among sites, small number of plots, hurricane disturbance, and changes in density of understory trees make interpretation uncertain. Changes in atmospheric carbon dioxide levels could

conceivably affect vine growth relative to trees, but climatic cycles or variation in natural disturbances such as storms could also cause reversible changes.

Most Coastal Plain floodplains show evidence of channel migration, and scars of past migration structure the landforms over large portions. However, migration is usually very slow or very infrequent. Rivers do not routinely change course in North Carolina. Channels are substantially vegetation-bound (Riggs et al. 1999), limiting how readily they can shift. The author has observed only three cases of meanders being cut off and one case of a more substantial course change, over three decades, despite record-breaking floods. Oxbow lakes are extremely scarce on brownwater floodplains; the frequency of their formation apparently is less than the time needed for alluvial deposition to fill them in. Oxbow lakes are more abundant on blackwater rivers, where much slower alluvial deposition allows them to last much longer, but they are still scarce. The presence of cut banks, fallen and leaning trees on banks, and unforested point bars indicates that meander migration remains active, but the small proportion of floodplains occupied by even older successional point bar vegetation demonstrates how slow the process is.

Most of the evidence of channel migration visible in the landforms of floodplains may have been formed in times of different climate. Either less vegetation, higher rainfall, or more extreme flows could have caused more rapid shifting in the past. Patterns on terraces provide evidence of these differences longer ago, showing wider channels, larger meander radii, and wider floodplains. Some terraces show that the Pleistocene river channel was braided, where a meandering channel now exists. Braided channels indicate greater sediment loading and reduced channel stability. Leigh et al. (2004) note that their existence in the recent geologic past is evidence that the current stability of rivers may be near a threshold and may be readily reversible with a small change in parameters.

Where channel migration is occurring, it creates new landforms that are colonized by natural communities that represent early primary succession, either on the bare sand of point bars or in the open water of oxbow lakes. While the results of channel migration create the environments that structure the community mosaic in most Coastal Plain floodplains, most of that mosaic does not appear to be primary successional communities. Dynamics where cypress swamps are established only as primary successional communities in abandoned channels, as suggested by Shankman and Drake (1990) and Shankman (1991) for western Tennessee, do not seem to be the norm in North Carolina.

Over most of the extent of floodplains, flooding is a natural process but not a significant natural disturbance. Sediment deposition may be extensive but generally in relatively thin layers. Scouring may remove small amounts of sediment but only rarely uproots the smallest plants. Floods move leaf litter and woody debris, creating wrack piles that increase local heterogeneity. Large debris carried by the largest floods may batter plants but does not appear to be a major source of mortality. Floods bring nutrients, making floodplain soils more fertile than other soils. This is especially true for brownwater rivers, with their large load of fine sediment and dissolved nutrients derived from a Piedmont watershed. This is also true, though to a less degree, for blackwater rivers. They are less fertile and presumably less productive but more so than nonriverine wetlands.

While flooding is not generally a significant natural disturbance, it is important in structuring communities and giving them their distinctive character. Altered flood regimes have important effects on communities, though these may be subtle, slow to become evident, and variable. Flood control dams, such as those on the Roanoke and Cape Fear rivers, eliminate the largest floods, leaving the highest portions of the floodplain without any flooding. Gradual invasion by upland vegetation may result. The same control also eliminates the lowest flows of the river and can prolong lower level floods of particular magnitude. This stresses wetter communities, especially the wetter portions of levee forests and bottomland hardwoods, which are subjected to longer flooding than their species are adapted to.

Movement of sediment by floods may also occasionally change communities locally, probably usually slowly but occasionally quickly. If a slough is blocked by sediment deposition along the riverbank, it will become wetter. Conversely, reworking of sediment blockage may improve drainage locally. Migration of point bars may open blocked sloughs. Accretion of sediment may gradually raise land surfaces, resulting in drier conditions for newly established plants. Oxbow lakes and other abandoned channels become shallower over time, as alluvial deposition fills them in. While sediment accretion is slow at present, there was a period of rapid deposition, especially in brownwater rivers, during the 1700s and 1800s caused by erosion driven by widespread clearing and plowing of uplands in the Piedmont. The full consequences of this influx are not clear, but natural levees are higher and perhaps wider and banks correspondingly higher. Sediment production rates are reduced now, thanks to modern agricultural practices and abandonment of much marginal farmland, but they presumably remain much higher than in prehistoric times. Most of the sediment was stored in floodplains in the Piedmont and Coastal Plain, where it continues to work its way downstream. Natural sediment transport rates and dynamics are further confounded by additional potential alterations: urbanization and the channel changes it induces in tributaries, the creation and abandonment of numerous mill ponds in the Piedmont, the presence of medium to large reservoirs, the extirpation and recent resurgence of beavers, navigational improvements, and in downstream reaches, effects of rising sea level.

The most poorly known natural dynamic process of floodplains is that of beavers. Beavers can dam small stream channels or may impound tributary streams or sloughs within large floodplains. A beaver dam on an outlet slough (gut) through a natural levee can impound a large area of backswamp. Beaver ponds can raise the local water table beyond the extent of standing water, in a complex pattern determined by microtopography.

Beavers have been returning to North Carolina for several decades, after a much longer absence since they were extirpated from the entire state during the colonial period. Little is known about their natural population dynamics, predation, disease, nor about past pond longevity and return intervals. An important question for small streams is whether all parts of a stream are suitable for pond building, so that beaver ponds appear randomly and eventually affect the whole area, or if certain favored sites are chronically ponded while others never are. In large river floodplains, only specific sites can be flooded by beaver dams, with the natural levees, high ridges, and some backswamps and sloughs not susceptible.

Fire does not appear to be important in most Coastal Plain Floodplains communities. The interspersion of wet areas leaves many of even the highest areas unlikely to be reached by fire

unless deliberately ignited by people. However, bottomland hardwoods on terraces and adjacent to uplands, as well as smaller floodplains, may burn.

One additional uncertainty about floodplain community dynamics concerns canebrakes. *Arundinaria tecta* is common in several floodplain communities on both brownwater and blackwater rivers, where it can attain moderate densities in the higher light levels near riverbanks. Canebrakes were historically associated with large floodplains in states farther west, but they have not been definitively linked to this setting in eastern North Carolina. The state's historically documented large canebrakes were in peatlands or nonriverine wetlands. Dense canebrakes are highly flammable and can burn intensely and frequently enough to exclude trees. At present densities, it is not continuous enough to promote fire spread. Frequent natural ignition might happen on river terraces where fire could spread from uplands, but that seems unlikely in the riverbank locations where the species currently is abundant.

Comments: Coastal Plain Rivers in the Southeastern US have been widely studied. Many but not all of the findings are applicable to North Carolina rivers. There has been substantial study of the vegetation of Coastal Plain rivers in North Carolina, but intensity has varied. It can be uncertain at times how much of the detailed classification of vegetation of one river applies to others. The Roanoke River has been especially well studied (Rice, et al. 2001), while the Neuse and Cape Fear have also been well studied (Faestal 2012). Blackwater rivers have received less study, with most of the information coming from Natural Heritage Program surveys and CVS plot data. Smaller streams have received much less study, though there are some CVS data.

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